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ABSTRACT

To determine if performing mental exercises (thinking skills which activate cognitive mental alertness) before taking a test affected test results, a study examined spelling test results of three ninth-grade English classes instructed by the same teacher. Subjects were of similar educational background and had similar characteristics representative of a middle class, suburban high school with a diverse socio-economic population. All three classes (control, specific mental exercise, and general mental exercise) took the same time-controlled, dictated spelling test. The control group (20 students) took the test with no mental exercises. Students in the specific mental exercise group (21 students) completed a mental warm-up exercise specifically related to spelling. Students in the third group (19 students) completed a general mental exercise. Both warm-ups were limited to five minutes, after which students took the spelling test. The procedure continued for three weeks. Although results indicated no significant difference in the test results of the three groups, all three groups had a significant gain in the difference between the premeasure and the postmeasure of each student's tests. The students treated with the specific mental exercises showed the most gain in test scores. (Seven tables of data are included, and 20 references are attached. Appendixes include the specific and general mental exercises and spelling tests used for the study.) (MM)

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MENTAL EXERCISES

A Study of the Effect of Mental Exercise as a Warm-up on the Test Scores of Students

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ABSTRACT

The purpose of this study was to determine if warming-up with mental exercises before taking a test had any effect on the test results. Three intact, homogeneously grouped, ninth grade English classes were selected for the study. The control sample, consisting of 20 students, had no treatment before beginning the scheduled spelling test. The specific mental exercise sample, consisting of 21 students, performed warm-up exercises on skills related to the task of the test. The general mental exercise sample, a group of 19 students, performed mental exercises on general thinking skills. The experiment involved three weeks of testing.

Athough the results indicated that there was no significant difference in the test results of the three groups, all three groups had a significant gain in the difference between the premeasure and the postmeasure of each student's tests. The students treated with the specific mental exercises showed the most gain in test scores.

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"The more you ask of your brain, the more it can do, the easier it will do it, and the quicker it will be done." (Corrigan, 1981)

What comforting words these can be for a student preparing for exams who feels he has totally "burned out" and has become incapable of another coherent thought. Research has disclosed that the brain can store and retrieve in the area of one million billion pieces of information; therefore, it is highly unlikely for anyone in his lifetime to mentally "burn out".

Intelligence is the capacity to think creatively, to recognize similarities and differences, to analyze information, to use knowledge to solve problems, to perceive relationships, to learn from mistakes, to understand concrete and abstract ideas, and to retain relevant information. (Greene, 1987) Yet, smartness is the capacity to apply intelligence. According to Greene, an important distinction must be made between a child's **Intelligence Quotient** (IQ) and his or her "**Smartness Quotient**" SQ. He defines SQ as a child's capacity to think strategically and develop

practical solutions to problems. In other words, your mental capacity is not necessarily something you have inherited, rather, it is the way of being you have developed. Smartness or alertness is an asset which the active mind is capable of developing. Skills required for problem solving are not necessarily related to IQ. (Torrance, 1979)

The 19th Austrian clergyman, Karl Witte, was an early pioneer in his methods for training children to have superior intellects. Likewise, Marie Montessori emphasized early stimulation for children to tap their true intellectual capacities. Their work was supported by Dr. Georgi Lozanov, a Bulgarian doctor and psychiatrist, who proposed that the brain has unlimited potential for learning and experimented with the Bulgarian Rapid Learning Method. (Lozanov, 1977) Also, Reuven Feurstein, an Israeli psychologist, aided psychologically and emotionally scarred Holocaust immigrant children who were considered total or functionally illiterate. His Learning Potential Assessment Device ascertained that cognitive gaps in the children's thinking skills could be remediated. All of these pioneers were successful in significantly raising the mental alertness of their subjects. Mental

exercises, or stretching the brain, appear to be most effective in stimulating the brain to deeper and more enriching thought.

Performance on tests is an important criterion for judging a student's capability. Such results affect not only the individual student, but also both local as well as district goals. Based on prior research, successful strategies, which can help a student think thoroughly and express his depth of knowledge completely, might be devised to allow him to manifest his optimum ability. To help the student in expressing his thoughts, it would appear to be important for him to focus on a task which stimulates his mental alertness just prior to a test. By performing mental exercises, or thinking skills which activate cognitive mental alertness, a student might be warmed-up and prepared to perform his best, similar to an athlete who warms-up and stretches his muscles before participating in a sporting event.

Hypothesis

To provide additional evidence concerning this topic, a study was conducted on the hypothesis that the

use of mental exercises will improve students' test scores.

Definitions

Mental exercises is defined as thinking skills which activate cognitive mental alertness.

Specific mental exercises is defined as warm-ups in thinking skills related specifically to the topic of the test.

General mental exercises is defined as warm-ups in general thinking skills unrelated to the topic of the test.

Test scores is defined as the results of the objective spelling test comprised of ten words from Warriner's Grammar, Third Course, dictated by the classroom teacher.

Methods and Procedures

Three intact, ninth grade, homogeneous samples of students were selected as subjects. Of the three, one control sample and two experimental samples were chosen arbitrarily. One experimental sample performed specific mental exercises just before taking a spelling test, while the other experimental sample performed general

mental exercises. For clarity, the groups will be referred to as Control Sample, Specific Mental Exercise Sample, and General Mental Exercise Sample.

The students are of average ability as validated by the mean score of the results of each student's **California Achievement Test**, which was administered in the spring of 1987, shown in Table 1.

TABLE 1

CALIFORNIA ACHIEVEMENT TEST

Means of the Samples

	Reading	Language Arts
Control Sample	45.7	53.4
Specific Mental Exercise Sample	44.6	48.8
General Mental Exercise Sample	46.2	45.1

In addition, an average for each student of six spelling tests, which were administered prior to the experiment, was compliled to establish a pre-mean spelling score for each sample. The mean spelling score

for the Control Sample was 69.4 ; the Specific Exercise Sample - 59.7 ; and the General Exercise Sample - 57.8.

The study reflects a simple selection of average ninth grade students placed in their English I General classes through the guidance department at the high school. It was assumed that the students were of similar educational background and had similar characteristics which were representative of a middle class, suburban high school with a diverse socio-economic population.

The three groups selected for the research were instructed by the same teacher. All three samples took the same time-controlled, dictated spelling test scheduled by the classroom teacher for Monday mornings. (See Appendix for sample). The Control Sample took the teacher-made test without any mental warm-up exercises. Students in the Specific Mental Exercise Sample were handed a ditto with a mental warm-up exercise specifically related to the task of the test: spelling (See Appendix). Students in the General Mental Exercise Sample were handed a ditto with a general mental exercise (See Appendix). Both Experimental Samples were limited to a five minute warm-up, after which the students took the spelling test. The procedure

continued for three weeks. Since the teacher was aware of the experiment, to insure the validity of the test scores, the papers were graded by an independent scorer who was unaware of each student's placement. In addition, to counteract the Hawthorne effect, the teacher had a set of predetermined instructions to read to the class while distributing the warm-up exercises on ditto paper.

The study was limited to an experiment before a teacher-prepared test because of the strict procedures required in administering a standardized test; however, it is assumed that the warm-up exercise technique would transfer to all types of testing situations.

Results

To analyze the results, mean scores of the spelling tests were compiled and compared utilizing Student's *t* tests to determine if there was any significant difference among the three groups as a result of the treatment. Table 2

Table 2

Comparison of Treatment for Control and Specific Samples

Sample	Mean	SD	t
Control	13.3	13.13	.64
Specific Mental Exercise	15.90	13.10	

39 DF

illustrates the findings in respect to the Control Group and the Specific Mental Exercise Group. As indicated by the table, a t of .64 was computed denoting that there was no significant effect on the group as a result of the treatment with specific mental exercises.

Table 3 illustrates a comparison of the mean score of the Control Sample with the General Mental Exercise Sample. A t of .04 was computed, indicating that the treatment with general mental exercises had no significant effect on the sample.

Table 3

Comparison of the Treatment for the Control and General Samples

Sample	Mean	SD	t
Control	13.3	13.3	.04
General Mental Exercise	13.53	19.63	

37 DF

Table 4 illustrates the findings in respect to the

Table 4

Comparison of Treatment for the General Sample and the Specific Sample

Sample	Mean	SD	t
General Mental Exercise	13.53	19.63	.45
Specific Mental	15.9	13.10	

38 DF

comparison of the mean score of the General Mental Exercise Sample with the Specific Mental Exercise Sample. A t of .45 was computed, again indicating that

there was no significant differences in the results of the samples regardless of the treatment.

Applying statistical tests to mean differences in the determining the effect of treatment on samples resulted in no significant differences. It appears that neither the treatment with specific mental exercises nor the treatment with general mental exercises had a significant effect on any of the samples. However, a comparison of each student's premeasure of the spelling test with the post measure of the spelling test shows a significant variability within the groups. As indicated in Table 5, when comparing the Control Sample's

Table 5

Control Sample's Premeasure vs. Postmeasure

Control Sample	Mean	SD	t
Premeasure	69.05	15.28	
3.05			
Postmeasure	82.35	12.04	

38 DF Sig < .01

premeasure with the postmeasure, a t of 3.05 was computed.

When comparing the Specific Mental Exercise Sample's premeasure with the postmeasure, a *t* of 2.79 was computed as indicated in Table 6.

Table 6

Specific Sample's Premeasure vs. Postmeasure

Specific Sample	Mean	SD	*t*
Premeasure	59.71	19.42	2.79
Postmeasure	76.09	18.58	

40 DF Sig < .01

Table 7 indicates a computed *t* of 2.16 when the

Table 7

General Sample's Premeasure vs. Postmeasure

General Sample	Mean	SD	*t*
Premeasure	56.26	20.19	2.16
Postmeasure	69.84	18.54	

36 DF Sig < .05

premeasure of the General Mental Exercise Sample was compared to the postmeasure.

As indicated by Tables 5, 6, and 7, all three samples had a significant difference between the mean of the premeasure and the mean of the postmeasure. These differences appear to be a direct reflection of the result of the treatment to which they were exposed.

Conclusions and Implications

Although the findings indicate that there is no significant difference as a result of the treatment among the three samples in the analysis of the Student's *t* tests, there appears to be a significant difference between the premeasure and postmeasure of all three samples. It is interesting to note the average improvement of at least 13 points on the mean score of the postmeasure of all three samples, with the Specific Mental Exercise Sample showing the most improvement (16.3) Table 6.

As an observer in the classroom, it was noticed that as the classroom teacher became involved in the experiment, more attention was concentrated on discovering why so many students had disappointing test results. An outcome was that the teacher placed more emphasis on helping the students to prepare for the tests. To illustrate, the class was structured so that

immediately after the test, the teacher gave instruction on the skills pertaining to the following week's assignment, and students were told to copy the new words to study. During the first week of the experiment, an average of 30% of the class had copied incorrectly one or more of the words to study. Upon observing this deficiency, the teacher became aware of the need to check the accuracy of the copied words and provide additional help with the study skills of the students. The implication is that the extra time the teacher spent in checking the words and alerting the students to their errors influenced the total improvement of all samples.

Another interesting observation is that as a result of the warm-up exercises both the Specific Mental Exercise Sample and the General Mental Exercise Sample seemed to settle into the task of the spelling test more smoothly and with fewer distractions than the Control Sample which had no warm-up treatment. In both exercise samples, class distractions such as students' questions, getting pencils, and physically and mentally settling into the task preceded the warm-up exercises rather than the test. The implication here supports the trend in classroom management to condition the students

to begin class with a five minute exercise, often referred to as a "Do Now". This helps the student to prepare both mentally and physically for the content of the day's lesson, thus maximizing the focus of attention.

It is also felt that although this sample selection of average ninth grade students was believed to be homogeneous, the inconsistencies in the group composite became obvious. Various factors affected the classes, and as a result, affected the experiment. Numerous schedule changes and new enrollments altered the make-up of the classes, limiting the selection to the core of students who remained constant. In addition, as a result of the changes, the mean of the CAT for the Control Sample was higher than either the Specific or General Samples. This advantage had a possible effect on the improvement indicated in the results of this sample's postmeasure in spite of having no warm-up exercises. Noted also was the inconsistency of the samples in the preparation for the tests on a regular basis. Individual scores varied greatly among the three weeks of testing, signifying that the students were inconsistent in their preparation for the tests. Because of these factors, it is felt that this

study would be worth replicating to insure accuracy in results.

What has been determined by the study is that many factors affect test results of students. One factor is the importance of a student to perceive correct information and, having correct knowledge, apply good study skills in preparing for tests. Another factor is the ability to focus one's concentration on the test by being physically and mentally prepared to direct attention to the task. It seems, in general, that a brief period of warm-up exercises has a beneficial effect on test results by helping a student to focus attention on the test. In addition, the findings indicate that the more closely related the exercises are to the topic, the greater the improvement.

Mental Exercises as a Warm-up:

Related Research

In the late 1800's, William James conducted one of the earliest American psychological experiments to determine whether or not mental exercise is effective. He and his students tested his theory by memorizing a poem by Victor Hugo under timed conditions. They exercised by memorizing a new poem by various authors every day. The final test was the timed memorization of a different Hugo poem. The findings determined a slight increase in the speed of memorization of the second Hugo poem, and James concluded that "Learning a great deal about material improves the readiness to understand material better." (James, 1920)

Thorndike's experiments with transfer of learning disclosed that the more similar the learning experience, the better the grasp of learning. (Thorndike, 1924)

Dr. Arthur Winter (1986) has estimated through his research that the brain has the greatest capacity to gather and store an infinite amount of information and to manipulate that data. Yet, he claims that people use only .01% to 10% of their brain power. Of the 15 billion neurons operating in the brain, the average person loses between 1 to 2 billion in a lifetime.

(Ehrenberg, 1985) However, experiments show that intellectually active adults can improve on IQ tests beyond the age of 60. Mental stimulation may actually increase the size of your brain. (Yepsen, 1987) Winter claims that motivation, repetition, and stretching are required to enrich the mind and improve cognition - cognition being the ability to focus and sustain attention, distinguish between relevant and irrelevant, organize and integrate, communicate, solve problems, and process information.

How does all this take place in the brain? Chemical messages (hormones) interact between the neurons of the brain and carry messages throughout the body, then relay the information from the provinces back to the brain. Richard Wurtman, M.D., professor of neuroendocrinology at MIT, suggests that the brain's sensitivity to substances flowing through the bloodstream enables it to monitor physical cycles. (Yepsen, 1987)

In the study of the thinking process, researchers have found that memories are stashed in holograms, formed by intersecting waves of energy. (Yepsen, 1987) The first step in forming memories is to observe, then

perceive the information. (de Bono,1970) Perception is necessary for the assimilation of new knowledge into the schemata. One is able to tap his memories (schemata) by using an instinctive reflex that takes place when trying to remember. For example, one can access the visual and tactile memory by directing eyes in a particular direction. Scientists speculate that memory is retrieved through an electrical current when brain waves scan and search for knowledge. (Corrigan,1981) Research in neuroanatomy has shown that the adult brain will use new connections between cells to meet the demands of a stimulating environment. Recognition patterns within the brain's visual cortex require outside stimulation to develop normally. (Restak,1986) Thus, the nervous system continues to grow with stimulation.

Experimentally, scientists have been successful in locating activity in certain brain areas when testing through the use of the PET scanner which detects radioactivity in areas injected with glucose. (McKean, 1987) Dr. Lyle Miller,Ph.D.,of the Behaviorial Science Department of the Boston University School of Medicine, is presently synthesizing neuropeptides to lengthen the attention span and increase absorption of visual

information. (Yepsen, 1987) Scientists also believe that lecithin and choline (found in the Vitamin B Complex) will prove promising in increasing the rate of the brain's metabolism as the key to memory function. (Yepsen, 1987)

Until these "magic potions" are perfected, what can the average person do to boost his brain power? The data shows that the brain, like a muscle, must be used in order to maintain optimal function. Both Alfred Binet and Edward de Bono assert that any mental skill can be improved with practice. (Torrance, 1979) If all is equal, it is the actively involved, mentally stimulated person who is least likely to develop senility. Findings signify that the mind will atrophy and stiffen if not exercised.

Learning is based on concentration and alertness, and concentration keeps the mind focused. Focusing with a purpose draws the attention to the task on hand. The term "active learner" is used to counteract passiveness. Strategies such as Advanced Organizers have been considered advantageous in developing a preparedness to read. Author Jordan E. Cohen claims that getting in the right frame of mind before a test

can boost your grades. (1987) Feuristein's studies (Sharron, 1987) determined that when Learning Disabled children were trained to apply verbal rehearsal, they performed similarly to normal children. Proponents of the Dock of the Bay (DOTB) strategy (Weaver and Cotrell, 1988) call mental aerobics "the stimulation (oxygenation) of the mind through well-planned, specific, and direct routine." The theory is practiced through guided verbal brainstorming of open-ended questions for a set period of time. The mental workout consists of a warm-up which is a mood setter such as a joke or survey, and ends with a cool-down to tie together, summarize, and conclude. Some benefits resulting from this warm-up include: learning, clarification, expression, immediacy, and comparisons.

Certain levels of thinking are more stimulating than others. For example, Bloom and Harris (Hevener, 1987) observed that questions requiring recognition or recall information demand much less of the student's thought process than questions involving analysis, synthesis or evaluation. According to Torrance (1979), there are four levels of provocative questions: 1) the lowest level of yes/no; 2) the question requiring an explanation; 3) the relationship

of information to experiences; and, 4) the highest level, the ability to project to the future. Although all levels of questions lead the student to focus, it is obvious that for a maximum workout, the warm-up should involve higher order thinking skills.

In conclusion, research has shown that mental exercise will help a student become intellectually alert and better able to focus his attention. Thus, a student who performs mental exercise to warm-up prior to a test should have more successful test results than a student who does not perform mental exercises.

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Appendix

SPECIFIC MENTAL EXERCISE

Warm-up exercises in thinking skills related specifically to the topic of the test.

WEEK 1

Directions: Fill in the missing vowels.

rec _ _ ve	chang _ _ ble	bel _ _ vable
notic _ _ ble	cr _ _ ly	ech _ _ s
gr _ _ ve	n _ _ se	th _ _ r

WEEK 2

Directions: Circle the misspelled word on each line.

heir, forrest, yield, truly

echoes, occasional, thier, rhyme

acommodate, niece, bore, weird

villain, guilt, ache, sincerly

procedure, sieze, humane, envelop

seperate, handkerchief, notoriety, scarcely

WEEK 3

Directions: Unscramble the following words:

lfes	_____	tste	_____
kabc	_____	enxt	_____
daip	_____	wmar	_____

GENERAL MENTAL EXERCISE

Warm-up exercises in thinking skills unrelated to the topic of the test.

WEEK 1

Directions: Circle the figure which is different:

A, K, L, j, C

3, 9, s, 1, 7

!, ?, :, ", %

j, k, l, o, p

#, !, =, >, +

O, O, O, O, O

WEEK 2

Directions: Fill in the next number in the series.

2,4,6,8,10,12,14, _____.

1,1,5,3,3,9,5,5, _____.

4,6,5,5,7,6,6,8, _____.

7,7,7,7,5,5,5,3,3, _____.

1,5,9,13,17,21, _____.

WEEK 3

Directions: Circle the letter of the correct answer.

1. An automobile always has **a.** hubcaps **b.** wheels
   c. a driver **d.** windows

2. A factory always has **a.** laborers **b.** steel
   c. machines **d.** a manager

3. A house always has **a.** wood **b.** a roof **c.** a porch
   d. a basement

4. A newspaper always has **a.** a printing press **b.** an editor
   c. a sports column **d.** editorials

5. A jungle always has **a.** plants **b.** monkeys **c.** rivers
   d. vines

SPELLING TEST

The spelling tests for each of the three groups consisted of a list of words extracted from the spelling section of Warriner's Grammar, Third Course. For each of the dictated words, the student was asked to write the plural form correctly.

WEEK 1

1. lady
2. relay
3. donkey
4. copy
5. butterfly
6. ally
7. lullaby
8. quantity
9. day
10. jalopy

WEEK 2

1. thief
2. chef
3. life
4. knife
5. giraffe
6. shampoo
7. soprano
8. torpedo
9. hobo
10. veto

WEEK 3

1. woman
2. foot
3. son-in-law
4. maid of honor
5. armful
6. mouse
7. man-of-war
8. deer
9. Chinese
10. ox